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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/681,343	10/09/2003	Shinichi Yamaguchi	402830/PALMO	3384

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EXAMINER	
NGUYEN, TRAN N	

ART UNIT	PAPER NUMBER
2834	

DATE MAILED: 06/02/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.** 10/681,343	**Applicant(s)** YAMAGUCHI ET AL.	
	Examiner Tran N. Nguyen	**Art Unit** 2834	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.
2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☐ Claim(s) *1-10* is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☐ Claim(s) *7-10* is/are allowed.
6)☐ Claim(s) *1,2,4 and 5* is/are rejected.
7)☐ Claim(s) *3 and 6* is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.
10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a)☒ All b)☐ Some * c)☐ None of:
1.☒ Certified copies of the priority documents have been received.
2.☐ Certified copies of the priority documents have been received in Application No. _____.
3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 1003, 0804
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. **Claims 1-2 and 4-5** are rejected under 35 U.S.C. 103(a) as being unpatentable **Nishiyama (JP-200-308286)** in view of **Fukushima (US 6,657,349).**

Nishiyama disclose a permanent-magnet rotating machine comprising:

a stator (not shown) having a cylindrical stator core in which said rotor is disposed, said stator core being provided with stator coils for producing a rotating magnetic field which causes said rotor to rotate;

a rotor (figs 1-4) having permanent magnets are arranged in two rows (31-32) along an axial direction in such a manner that the permanent magnets in one row are skewed from the permanent magnets in the other row in a circumferential direction by a row-to-row skew angle (θ_{skew}) expressed in terms of a mechanical angle.

As admitted prior-art, by the applicant's discussion in Background of the Invention, that Nishiyama reference particularly discloses a theoretically determined angle ($\theta_{theoretical}$) is used as the row-to-row skew angle (θ_{skew}). The $\theta_{theoretical}$ at which the cogging torque is expected to be minimum is calculated as:

360 / {(the least common multiple of the number of stator poles and the number of rotor poles) / (the number of permanent magnet rows along the axial direction)} (in mechanical angle)

Those skilled in the art would notice that Nishiyama calculating method for the skew angle (θ_{skew}) involves the following parameters:

- number of stator poles;
- number of rotor magnet poles;
- the least common multiple of the numbers of stator and rotor poles respectively;
- the number of permanent magnet rows.

Also, Nishiyama calculates the theoretical angle ($\theta_{\text{theorethical}}$) in mechanical degrees instead of calculating it in term of electrical degrees. Nevertheless, the two measuring units (mechanical degree and electrical degree) can be easily converted to one another. Thus, regarding the recited a theoretically determined angle θs to be determined as

*180 * {(the number of rotor poles / the least common multiple of the number of stator poles and the number of rotor poles) / (the number of permanent magnet rows along the axial direction)} (in electrical degrees)*

Those skilled in the art would understand that, even though the math expression of claimed invention is different from the Nishiyama's math expression; nevertheless, both the claimed invention theoretical angle theoretical angle (θ_s) and the Nishiyama's theoretical angle theoretical angle ($\theta_{\text{theorethical}}$) are determined base on the same factors of

- number of stator poles;
- number of rotor magnet poles;
- the least common multiple of the numbers of stator and rotor poles respectively;
- the number of permanent magnet rows.

Therefore, those skilled in the art would understand that this would be a matter of expressing knowledge in terms of mathematical expression. *A novel and useful structure* created with the aid of knowledge of scientific truth may be patentable, in this case the theoretical angle is determined based on the factors of number of stator poles, number of rotor magnet poles, the least common multiple of the numbers of stator and rotor poles respectively, and the number of permanent magnet rows, as disclosed by Nishiyama. These are actual structural elements that would directly affect the torque of the motor. It has been held that a scientific truth or the mathematical expression of it is not patentable invention. *MPEP 2106 Patentable subject matter, Mackay Radio & Telegraph Co. V. Radio Corp. Of America, 306 US 86, 94 (1939) and Warmerdam, 33 F.3d at 1360, 31 USPQ2d at 1759.*

Nishiyama substantially discloses the claimed invention, except for the following:

(a) a rotor having a rotor core carrying on its curved outer surface multiple permanent magnets;

(b) the skew angle (θe) is calculated with respect to the theoretical angle θs to be in the range of lower limit to be larger than the theoretical angel of θs of 30 degrees and the upper limit of the skew angle θe is not exceed 43 degrees, i.e. skew angle θe is set to be within the range of 30 < θe <43 (electrical degrees), or the two permanent magnets forming one pair of north and south poles are offset from equiangular points by one-half times the theoretical θs so that they are located farther away from each other in each row of the permanent magnets.

Regarding the limitations of the subsection (a) herein, **Fukushima** disclose a permanent-magnet rotating machine comprising: a rotor (fig 5) having a rotor core (13) carrying on its curved outer surface multiple permanent magnets (16A, 16B) which are arranged in two rows along an axial direction. Such rotor with rotor magnetic core and magnets thereon would provide high magnetic characteristics, with strong structural integrity to sufficiently withstand the centrifugal forces during rotation. Furthermore, a rotor with rotor core carrying on its curved outer surface multiple permanent magnets is well known in the art.

Thus, it would have been obvious to one skilled in the art at the time the invention was made to modify the motor by figuring the rotor with a rotor core carrying on its curved outer surface multiple permanent magnets, as taught by Fukishima. Doing so would provide a rotor with high magnetic characteristics, with strong structural integrity to sufficiently withstand the centrifugal forces during rotation.

Regarding the limitations of the subsection (a) herein, **Fukushima Fukushima** disclose a permanent-magnet rotating machine comprising:

a rotor (fig 5) having a rotor core (13) carrying on its curved outer surface multiple permanent magnets (16A, 16B) which are arranged in two rows along an axial direction in such a manner that the permanent magnets in one row are skewed from the permanent magnets in the other row in a circumferential direction by a row-to-row skew angle θ' expressed in terms of an electrical angle; and

a stator (12) having a cylindrical stator core in which said rotor is disposed, said stator core being provided with stator coils (not shown) for producing a rotating magnetic field which causes said rotor to rotate; wherein the number of magnets (16A and 16B) of the rotor 13 has eight magnetic poles, and the stator iron core 12 has twelve pole (or slots).

Therefore the ratio of the number of rotor poles to the number of stator poles is 2:3 that is a determining factor to calculating the skew angle for the magnets.

Fukushima generally discloses the method of calculating the optimal skew angle θ in the rotor magnet (having eight magnetic poles and twelve slots, i.e., the ratio between numbers rotor poles and stator poles is 2:3) will be given as following:

In a case, torque ripples are generated during one rotation (of 360 degrees) of the rotor, with the number of torque ripples corresponding to the least common multiple of the number of magnetic poles and the number of slots. In other words, the torque ripples are produced in a 15-degree period.

Therefore, in order to minimize cogging torque, it is necessary to determine the skew angle θe so that it makes it possible for the generated cogging torques to have opposite phases and cancel each other. In this case, the optimal skew angle corresponds to half the period of the cogging torque. In order to cause the motor to provide high output, the rotor magnets are shifted by the skew angle θ which is determined based on the number of torque ripples per rotation of the rotor determined by the number of slots in the stator-side iron core and the number of magnetic poles of the annular magnets formed by splitting the magnet into two in the axial direction. Here, the annular polar magnets of the rotor have eight magnetic poles, and the stator iron core has twelve slots. In this case, the skew angle θ, which causes the cogging torque to be a minimum is determined based on the number of torque ripples per rotation of the rotor determined by the number of slots in the stator-side iron core and the number of magnetic poles of the annular magnets. In other words, the angle obtained by adding to the skew angle θ a value, which takes into consideration magnetic interference between the split annular pole magnets becomes the skew angle θ.

In conclusion, Fukushima discloses the calculating method to determine *the skew angle θ being determined based on the number of torque ripples per rotation of the rotor determined by the number of slots in the stator-side iron core and the number of magnetic poles of the rotor-side annular magnets.*

Therefore, based on this disclosure, it would have been obvious to an artisan to determine the appropriate skew angle θ with respect to the number of number of rotor poles and the number of stator poles, including the number of magnet rows that form the total number of rotor magnet poles, in order to optimum the reduction of cogging torque and torque ripple therein so that the efficient performance of the motor is enhanced. Since Fukushima disclose the general method of calculating the skew angle to minimize cogging torque, it would have been obvious to an artisan to determine the appropriate skew angle's upper and lower limit range because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. ***In re Aller, 105 USPQ 233 (emphasis added).***

Thus, based on the Fukushima's method of calculating the skew angle, with the ratio of rotor poles and stator pole to be 2(n):3(n), it would have been obvious to one skilled in the art at the time the invention was made to modify the motor by figuring the lower and upper limits of the skew angle of the rotor magnets as recited in the present application. Doing so would enable the optimum the reduction of cogging torque and torque ripple therein so that the efficient performance of the motor is enhanced.

Furthermore, it would have been obvious to an artisan to determine the appropriate skew angle's upper and lower limit range because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. ***In re Aller, 105 USPQ 233 (emphasis added).***

Allowable Subject Matter

Claims 3 and 6 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 7-10 are allowed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tran N. Nguyen whose telephone number is (571) 272-2030. The examiner can normally be reached on M-F 7:00AM-4:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Darren Schuberg can be reached on (571)-272-2044. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Tran N. Nguyen
Primary Examiner
Art Unit 2834